



## Process Development Unit

*A modular, fully integrated, full-size biomass preprocessing system*

**P**oor feed handling is one of the primary reasons commercial plants that process bulk solids often operate at a fraction of design capacity during their first year.

A single feed handling problem—anything from a plugged auger to a broken conveyor—may bring the plant to a standstill until the problem is resolved.

Researchers at the Department of Energy's Biomass Feedstock National User Facility (BFNUF) specialize in scale up and integration of biomass preprocessing facilities. The BFNUF's primary capability is the Process Development Unit (PDU), a full-size, fully integrated feedstock preprocessing system.

The PDU allows industry partners to test a variety of size reduction, milling, drying, pelletizing, cubing, torrefaction, and mechanical and chemical separation options.

The PDU's flexible configuration allows for insertion of third-party equipment and a wide range of process designs so biorefineries can minimize or eliminate feed handling problems before costly setbacks occur.

The PDU and its counterparts—the Characterization Laboratory and the Bioenergy Feedstock Library—offer the bioenergy industry a world-class feedstock preprocessing research and development resource.

### PDU OVERVIEW

The PDU processes a variety of feedstocks at up to 5 tons per hour. Since its construction in 2009, it has processed more than 1,500 tons of feedstocks.

#### *Examples of PDU capabilities:*

- Toll processing for research and development
- Feedstock supply sourcing and custom blends
- Industrial feedstocks developed at commercial specifications
- Validation and testing of third-party technology
- Multiple sources of the same feedstock type for variability comparisons
- Full-scale control and equipment test bed

*The PDU allows industry partners to test a variety of size reduction, milling, drying, pelletizing, cubing, torrefaction, and mechanical and chemical separation options.*

*The PDU offers solutions for more than natural materials like pine residue and corn stover. Municipal solid waste can also be processed at INL's PDU.*



#### **Examples of feedstocks tested at the PDU:**

- Agricultural residues: corn stover, wheat straw, sugar cane bagasse
- Grasses: switchgrass, miscanthus, energy sorghum, reed canary grass
- Woody biomass: tree chips, logging residues
- Municipal solid waste
- Cellulosic coproduct
- Circuit boards and other electronic wastes

#### **MODULAR DESIGN**

The PDU is comprised of multiple modules including decomposition, sorting/fractionation, milling, drying and densification. The modular system provides easy reconfiguration allowing users to conduct process development, design and scale up of preprocessing and feed-handling systems at INL's 27,000-square-foot high bay in Idaho Falls or at partner locations.

#### **Decomposition**

- Bale deconstruction with bale capacity of up to 4-by-4- foot cross sections
- Shredding of bulk materials like municipal solid waste
  - » plastics
  - » electronics
  - » food scraps
- Size reduction for bales and bulk material through screens ranging from 6 inches to 3/16 inch
- Wood chipping
- Compression milling
- Attrition milling

#### **Sorting/Fractionation**

- Air classification at multiple scales
- Robotic sorting
- Gravity or density separation
- Contaminant removal by rock trap
- Magnetic separation
- Mechanical separation or screening

#### **Milling**

- Hammer, knife and shear milling

#### **Drying**

- Three-pass rotating drum
- Variable heat furnace
- Variable blower
- Torrefaction
- Pneumatic conveyance
- Drag chain, belt and screw conveyors
- Plenum chamber: pneumatic-assisted grinding, dust collection and control
- Metering bin: decouples upstream and downstream feed-handling rates

#### **Densification**

*Densifies ground material to more than 40 pounds per cubic foot*

- Pellets, cubes or briquettes
- Cooler improves quality and durability
- Super sacks
- Compression bags
- Bulk loading

The PDU's control room has two computer workstations, which allow operation of integrated equipment via a Distributed System Manager. A data logger records measurements from various instrument sensors and motor current draws. These measurements allow the operator to track and record important variables such as moisture and grinding energy to help partners understand trade-offs during commercial-scale preprocessing.

*Battelle Energy Alliance manages INL for the U.S. Department of Energy's Office of Nuclear Energy. INL is the nation's center for nuclear energy research and development, and also performs research in each of DOE's strategic goal areas: energy, national security, science and the environment.*

#### **FOR MORE INFORMATION**

##### **Technical contact**

**Neal Yancey**

208-526-5157

[neal.yancey@inl.gov](mailto:neal.yancey@inl.gov)

##### **General contact**

**Abby Todd**

208-526-6166

[abby.toddbloxham@inl.gov](mailto:abby.toddbloxham@inl.gov)

[www.inl.gov](http://www.inl.gov)

A U.S. Department of Energy  
National Laboratory

